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IS 8405 (2005): Circular Thread Rolling Dies -Specification
[PGD 32: Cutting tools]

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(पहला पुनरीक्षण)

Indian Standard

THREAD ROLLING CYLINDRICAL DIES — SPECIFICATION

(First Revision)

ICS 25.100.50

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2005 **Price Group 5**

Drills, Reamers and Threading Tools Sectional Committee, MGP 10

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Drills, Reamers and Threading Tools Sectional Committee had been approved by the Medical Instruments, General and Production Engineering Division Council.

This standard was first published in 1976. Based on experience gained and to align the standard with standards of other countries, this standard has been revised. This revision besides other changes incorporates following:

a) Grading of dies now deleted,

b) Seven types of dies according to applicable thread rolling machine are incorporated,

c) Outside diameter tolerance has been included, and

d) Test methods for various requirements have been included.

In the preparation of this standard considerable assistance has been derived from JIS B4501 : 1996 'Thread rolling cylindrical dies' issued by the Japanese Industrial Standards Committee.

Useful information for the manufacturers and users of these dies on the process of thread rolling is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

THREAD ROLLING CYLINDRICAL DIES — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies the dimensional and other requirements of thread rolling cylindrical dies used for thread rolling of external threads on bolts, studs, screws and similar components by rolling.

2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1586 : 2000	Method for Rockwell hardness test for metallic material (Scales A-B-C-D-E-F-G-H-K 15N, 45N, 15T, 30T and 45T) (*third revision*)
2102 (Part 1) : 1993	General tolerances: Part 1 Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)
3748 : 1990	Tool and die steels — Specification (*second revision*)
7859 : 1975	Gauge allowances and manufacturing tolerances for plain gauges for inside measurements for ISO fit sizes (nominal size upto 500 mm)

3 TERMINOLOGY

3.1 Thread Roller — A roller of cylindrical form, bored for mounting on a mandrel. On the periphery is a thread form which as a result of production process, forms the thread on the components. Thread rollers, when used in thread rolling machines are always used in sets, either a pair or a set of three (*see* Fig. 1).

3.2 Width — The dimension of the threaded part measured parallel to the axis.

3.3 Major Diameter — The diameter over the crests of the threads.

3.4 Recess — The annular relief provided in some bores to facilitate grinding.

3.5 Thread — The form on the periphery which provides the thread on the component.

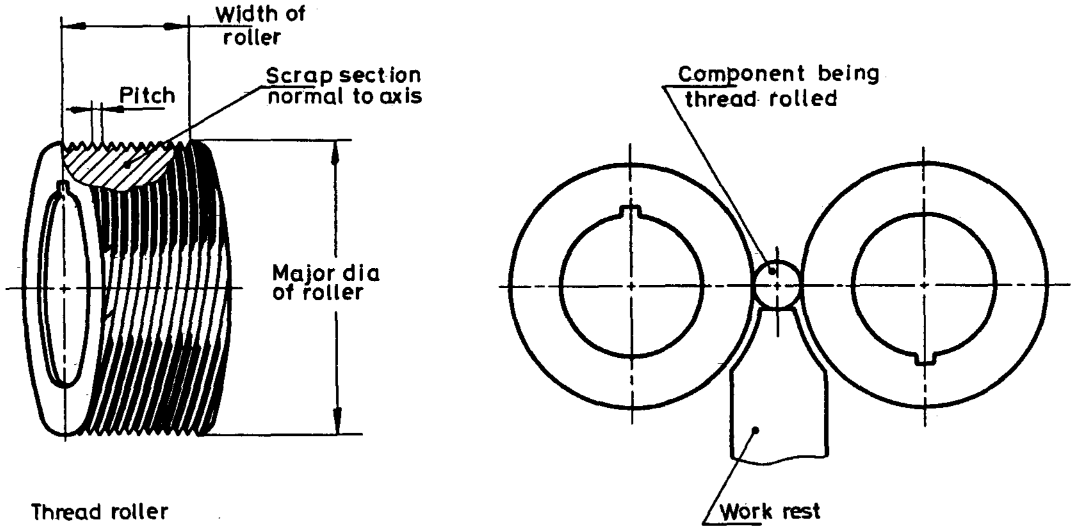


FIG. 1 DIAGRAMMATIC LAYOUT OF A PAIR OF THREAD ROLLERS

They are generally of the multi-start type, the actual number of starts being a function of the outside diameter of the thread roller and the method of application for which they are intended, that is, plunge or through rolling.

In the process of 'plunge rolling' the thread rollers are brought in radially towards the centre of the component in a similar manner to the plunge-cut of a grinding wheel. For this application the number of starts of the thread and the diameter of the rollers are so calculated that the helix angle of the thread roller and that of the rolled thread approximately correspond with the result that there is no appreciable axial movement of the component during the rolling operation.

In 'through rolling' there is axial travel of the component through the thread rollers. The number of starts of the thread rollers and the diameter of the thread rollers are, in this instance, calculated to produce a smaller angle of the thread roller helix than that of the component thread and the amount of axial movement is proportionate to the difference.

NOTE — The threads on the thread rollers are manufactured with a left-hand helix when intended for the production of components with right-hand threads and with a right-hand helix when intended for the production of left-hand threads.

3.6 Pitch — The axial distance between corresponding points on adjacent thread forms.

3.7 Lead — The axial distance travelled by any one thread in one revolution (equal to the pitch multiplied by the number of starts).

4 TYPES

The types of the dies shall be 7 types of Type 1, Type 2, Type 3, Type 4, Type 5, Type 6 and Type 7 according to the applicable thread rolling machines.

5 SHAPES AND DIMENSIONS

5.1 The shapes and dimensions of the dies shall be in accordance with Table 1.

5.2 Dimensional Tolerances

The tolerances on the outside diameter, width, hole diameter and width of keyway of dies shall be in accordance with **5.2.1** to **5.2.4**.

5.2.1 *Tolerances on Outside Diameter, D*

The tolerances on outside diameter *D*, shall be as given in Table 2.

5.2.2 *Tolerances on Width, W*

The tolerance on width *W*, shall be the medium class specified in IS 2102 (Part 1).

5.2.3 *Tolerances on Hole Diameter, d*

The tolerances on hole diameter *d*, shall be as given in Table 3 (*see* IS 7859).

5.2.4 *Tolerances on Width of Keyway, F*

The tolerances on width of keyway *F* and the tolerances on corner roundness of keyway *r*, shall be as given in Table 4.

6 TESTS

6.1 Workmanship and Finish

The dies shall be free from such defects, as sand marks, cracks, injurious flashes, flaws and rust and the finish shall be satisfactory.

6.2 Hardness

The hardness of dies when tested in accordance with IS 1586 shall be 58 HRC, *Min*.

6.3 Accuracy of Each Part

6.3.1 *Accuracy of Thread Part*

The accuracy of thread part when tested in accordance with **8.1** to **8.3** shall be as given in Table 5.

6.3.2 *Mutual Error on Outside Diameter, D*

The mutual error on outside diameters at an arbitrary place of a set of dies when measured with external micrometer or vernier caliper shall be as given in Table 6 according to the division of width *W*.

6.3.3 *Mutual Error on Width W*

The mutual error on width *W* of a set of dies when measured with external micrometer or vernier caliper shall be 0.1 mm, *Max* for width upto 120 mm and 0.2 mm, *Max* for width above 120 mm.

6.4 Runout

6.4.1 *Circumferential Runout on End Face*

The tolerance value of circumferential runout on end face of dies (the axial line of hole shall be taken as the datum) when tested in accordance with **8.4** shall be as given in Table 7.

6.4.2 *Circumferential Runout on Thread Part*

The tolerance value of the circumferential runout on thread part (the axial line of hole shall be taken as the datum) when tested in accordance with **8.4** shall be as given in Table 8.

7 MATERIAL

The material of the dies shall be of IS designation T160Cr12 or IS designation XT215Cr12 specified in IS 3748 or that having the performances equal to or superior to this.

8 TEST METHODS

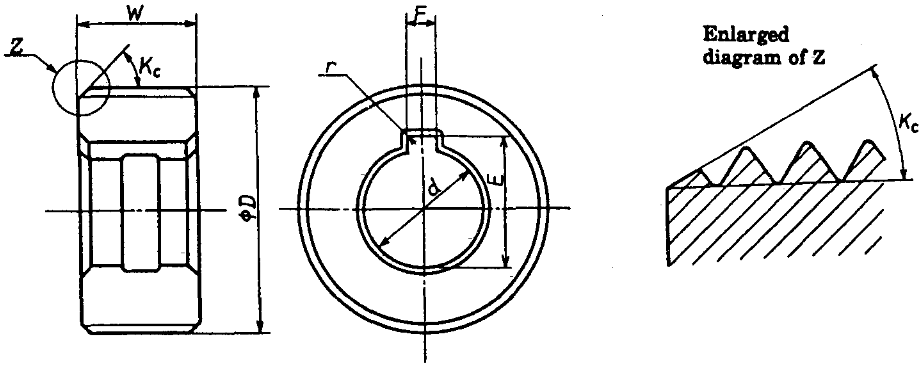
8.1 Accuracy of Thread Parts (h_a and h_d)

Allow the pitch line of threads to align with the cross

Table 1 Shapes and Dimensions

(*Clause* 5.1)

All dimensions in millimetres.



Type		Type 1	Type 2		Type 3		Type 4		Type 5			Type 6		Type 7
Hole Diameter, *d*		26	40		54		54		54	70		70	85	100
Width, *W*		30	40, 50		40, 60, 80, 100		40, 60, 80, 100, 120		40, 60, 80, 100, 120, 150, 180			60, 80, 100, 120, 150, 180, 200, 250, 300		100, 120, 150, 180, 200, 250, 300
Dimensions of Keyway	*F*	5	(4)	6	(10)	12	(10)	12	12	(14)	15	15	18	24
	E (ref)	28.5	43.5		59		59		59	74.5	77	77	91.5	109

NOTES

1 The chamfer angle K_c, of threaded portion shall generally be 30°. The shape of the crests after chamfering work shall be as agreed to between the parties concerned with delivery.

2 The recess of the hole portion shall be provided, as required.

3 The outside diameter, D of dies shall be in accordance with the following formula:

$$D = d_2 \times N + \frac{2}{3} H$$

where

d_2 = basic dimension of the pitch diameter of thread to be rolled,
N = number of starts of dies, and
H = fundamental triangle height.

4 The width of keyway F given in ( ) should not preferably be used.

Table 2 Tolerances on Outside Diameter, *D*

(*Clause* 5.2.1)

All dimensions in millimetres.

Sl No.	*D*	Tolerances
(1)	(2)	(3)
i)	100 or under	0 – 0.6
ii)	Over 100	0 – 1

Table 3 Tolerances on Hole Diameter, *d*

(*Clause* 5.2.3)

All dimensions in millimetres.

d	Tolerance (H7)
(1)	(2)
26	+0.021 0
40	+0.025 0
54	+0.030 0
70	
85	+0.035 0
100	

Table 4 Tolerances on Width of Keyway, *F* and Roundness of Keyway, *r*

(*Clause* 5.2.4)

All dimensions in millimetres.

F		*r*	
Basic Dimension	Tolerances (E12)	Basic Dimension	Tolerances
4	+0.140 +0.020	0.8 1.2	0 – 0.3
5			
6			
10	+0.175 +0.025	1.6	0 – 0.5
12	+0.212 +0.032		
14			
15			
18		2.4	
24	+0.250 +0.040		

line of measuring microscope (*see* Fig. 2), read the scale of micrometer and next allow the cross line to align with the crest or root to be measured and read the scale of micrometer. Consider the difference between the readings at this time to be the actual measured value.

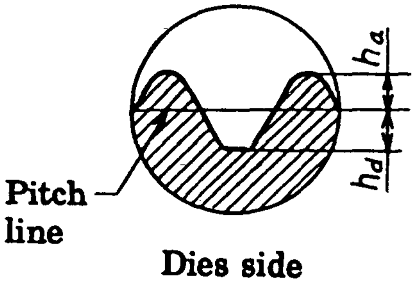


FIG. 2

8.2 Accuracy of Pitch

Allow the pitch line of threads to align with the travelling direction of measuring table (*see* Fig. 3) tilt the body tube of measuring microscope by the degree of lead angle, allow the thread *A* to align with the cross line of microscope and read the scale of microscope. Next, allow the cross line to align with the thread *B* by moving the travelling table to the thread *B* at a distance of necessary number of threads and read the scale of micrometer. Consider the difference between the readings of *A* and *B* to be the measured value.

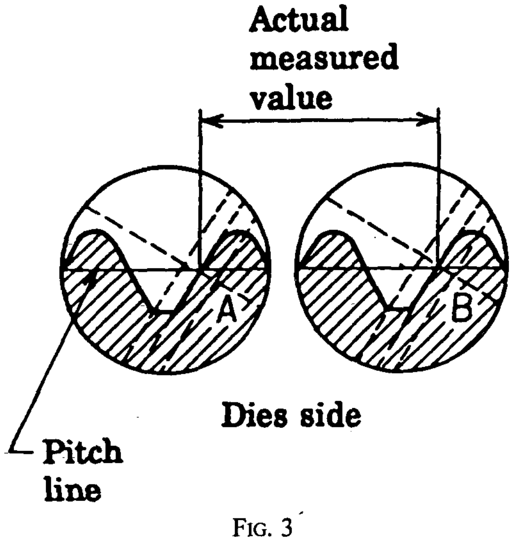


FIG. 3

8.3 Accuracy of Half Angle of Thread

Allow the pitch line of threads to align with the travelling direction of measuring table (*see* Fig. 4) tilt the body tube of measuring microscope by the degree of lead angle, adjust the cross line of microscope to the flank face of thread and take the reading of its rotated angle $\frac{\alpha_1}{2}$ by measuring microscope. Measure $\frac{\alpha_2}{2}$ as in the same manner as above.

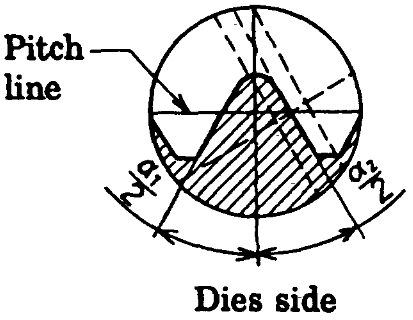


FIG. 4

8.4 Circumferential Runout on End Faces and Thread Part

Mount a dies to the centre stand, apply dial gauges of LC 0.001mm or micro indicators to the position of the end face near the outer periphery and the thread part at right angles respectively (*see* Fig. 5) and measure the maximum deflection of pointer while rotating the dies. Consider the axial line of hole to be the datum.

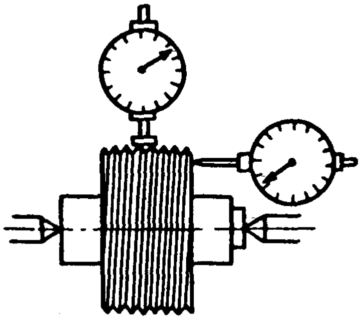


FIG. 5

9 DESIGNATION

The dies shall be designated by this standard number or title of this standard, designation of screw threads to be rolled, type, hole diameter, width of keyway, width of dies and material symbol. However, when the screw threads to be rolled are of left-hand thread, a letter 'left' shall be prefixed to the designation of screw thread to be rolled.

Examples:

1) IS 8405 M10 × 1.5 3 – 5412 – 60 × T160 Cr 12

2) Thread rolling cylindrical dies

Left M16 × 1.5 5 – 7015 – 150 × T 215 Cr 12

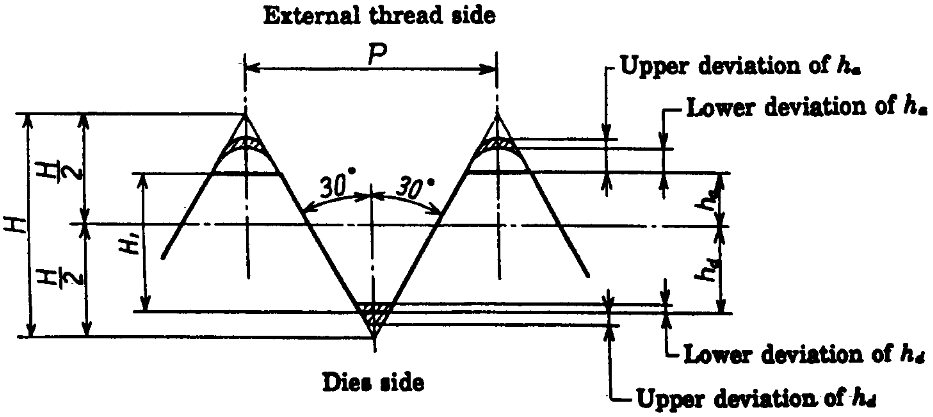
10 MARKING

10.1 The following information shall be marked on each end face of dies which comprise one set:

a) Symbol 'L' when the screw threads to be rolled are of left-hand threads (when the threads to be rolled are of right-hand threads, no symbol is to be marked);

Table 5 Accuracy on Thread Parts of Dies for Metric Coarse Screw Threads and Metric Fine Screw Threads

(*Clause* 6.3.1)



$H = 0.866\,025P$

$h_a = 0.216\,506P$

$H_1 = 0.541\,266P$

$h_d = 0.324\,760P$

Pitch *P* mm (1)	h_a		h_d		Pitch Tolerance (per 25 mm) µm (6)	Tolereance on Half Angle of Thread *Min* (7)
	Basic Dimension mm (2)	Tolerances µm (3)	Basic Dimension mm (4)	Tolerances µm (5)		
0.4	0.087	+36 +29	0.130	+11 -8	±15	±45
0.45	0.097	+42 +32	0.146			
0.5	0.108	+45 +36	0.162	+12 -8		±40
0.6	0.130	+55 +43	0.195	+13 -9		
0.7	0.152	+63 +50	0.227	+14 -10	±15	±35
0.75	0.162	+67 +54	0.244	+15 -10		
0.8	0.173	+71 +58	0.260	+15 -11		
1	0.217	+87 +72	0.325	+17 -12		±30
1.25	0.271	+107 +90	0.406	+19 -13		±25
1.5	0.325	+126 +108	0.487	+21 -15		
1.75	0.379	+146 +126	0.568	+22 -16		
2	0.433	+165 +144	0.650	+24 -17		±20

Table 5 — *Concluded*

Pitch *P* mm (1)	h_a		h_d		Pitch Tolerance (per 25 mm) µm (6)	Tolereance on Half Angle of Thread *Min* (7)
	Basic Dimension mm (2)	Tolerances µm (3)	Basic Dimension mm (4)	Tolerances µm (5)		
2.5	0.541	+204 +180	0.812	+27 −19		
3	0.650	+242 +216	0.974	+29 −21		±15
3.5	0.758	+280 +252	1.137	+32 −22		
4	0.866	+318 +288	1.299	+34 −24		
4.5	0.974	+356 +324	1.461	+36 −25		
5	1.083	+394 +360	1.624	+38 −27		
5.5	1.191	+431 +396	1.786	+40 −28		±12
6	1.299	+469 +432	1.949	+42 −29		

NOTES

1 Pitch tolerances in this table mean those corresponding to the sum of pitches between the arbitrary two crests of 25 mm apart. When the pitch tolerances corresponding to the dimension *l* mm other than 25 mm are required (for the dimension of standard length of fit or under, *l* shall be the standard length of fit), the value multiplied by $0.2\sqrt{l}$ to the numerical value in this table shall apply. When the dies have progressive pitch error, those which are remarkably not identical in tendency shall not be combined as a set.

2 Thick continuous lines of the above mentioned diagram indicate the basic profile and the hatched parts indicate the tolerance zone of dies.

3 Crest of the dies shall be rounded by 0.125 *P* or over.

4 Corner roundness of thread root of the dies shall not exceed 0.1 *P*.

Table 6 Mutual Error on Outside Diameter, *D*

(*Clause* 6.3.2)

All dimensions in millimetres.

Sl No. (1)	Division of *W* (2)	Mutual Error *Max* (3)
i)	120 or under	0.050
ii)	Over 120	0.075

Table 7 Tolerance Value of Circumferential Runout on End Face

(*Clause* 6.4.1)

All dimensions in millimetres.

Sl No. (1)	*D* (2)	Tolerance *Max* (3)
i)	Up to 100	0.015
ii)	Over 100 to 180	0.030
iii)	Over 180	0.045

Table 8 Tolerance Value of Circumferential Runout on Thread Part

(*Clause* 6.4.2)

All dimensions in millimetres.

Sl No. (1)	*D* (2)	Tolerance *Max* (3)
i)	160 or under	0.025
ii)	Over 160	0.040

b) Designation of screw threads to be rolled. For example: M10 × 1.5;
c) Type;
d) Symbol of material; and
e) Manufacturer's name or trade-mark.

10.2 BIS Certification Marking

The dies may also be marked with the Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11 PRESERVATIVE COATING AND PACKING

Each die shall be coated with grease or some other lubricant oil to make it resistant against corrosion and other atmospheric effects and packed in a suitable plastic paper.

ANNEX A

(*Foreword*)

THREAD ROLLING WITH CIRCULAR THREAD ROLLERS ON THREAD ROLLING MACHINES

The rolling process of producing screw threads differ from other methods is that material is not cut away to leave the desired thread but is caused to flow into its new form. A well produced rolled thread has in fact an actual grain flow which follows the thread contour. Providing that all materials and other relevant details are correct, a component on which a thread has been produced by this process can be expected to be stronger than one of comparable size and material screwed by other methods. This is of importance in many applications where studs, bolts, etc, are lightly stressed.

This increase in strength is most marked in cases of repeated loading (fatigue) where provided the component is not heat-treated after thread rolling, the increase may be as much as 50 to 100 percent.

This process is speedy, economical and accurate but its success depends in the main upon factors which shall be controlled before starting production rather than during the running of the machines. Such items as the diameter of the blank component and the relation of the outside diameter of the thread roller to the blank are vital. Any given machine is designed to work with rollers falling within a certain diametral range; these should be specified by the manufacturer and borne in mind by the user when preparing a set-up for production.

The first important factor in plunge rolling is that the effective diameter of the thread on the roller shall be multiple (an integer) of the theoretical effective diameter of the component to be rolled. The helix angle of the roller and that of the effective diameter of the component coincide once only during the operation at the point of completion of the rolled thread form. It should be noted, however, that this coincidence of the helices is only at the pitch line, a slight error being present at the points of conjuction of crest and roots. Such errors are infinitesimal and self-cancelling and at the moment of completion the component would, if left, revolve freely between the rollers without axial movement. At the commencement of the operation, however, the situation is different. There is difference in the helices at the moment of first contact which results in an endwise movement of component, the direction depending upon the outside diameter of the rolls and direction of their rotation. A clockwise rotation of the rollers (the references are to right-hand threaded components) coupled with a roller diameter larger than the optimum, will result in an axial movement away from the rollers. As the rollers wear and are reground, this outward axial movement will gradually be reduced to zero then reversed. The latter, an inwards travel, can become dangerous to machine, rollers and component if allowance is not made when the components are required to be threaded up to a shoulder.

In through rolling the practice can be to arrange for the effective diameter of the thread on the roller to be a variable arbitrary multiple of the theoretical effective diameter of the component to be rolled, dependent on the rate of through rolling desired.

As the operation is essentially one producing grain flow it is imperative to choose material which has the necessary properties. The next most important requirement is close control of the diameters of the blanks before rolling. Normally these should be identical with the required effective diameter of finished thread; actually there are certain variables. It is not generally considered necessary to fill the roller threads completely when rolling, nor therefore to attempt to form perfect crests. If, however, an occasion does arise when such a condition is necessary, then the blank diameter before rolling should be held approximately from 0.012 to 0.030 mm above the required effective diameter. For rolling threads to close fit the limits of tolerance before rolling should be around 0.012 mm for diameters up to 12.5 mm but this figure may be exceeded when medium and free fits are required. If blanks are used which before rolling, are oversize, then oversize threads will result. Any attempt to reduce the effective diameters by closing in the thread rollers will result in lowest blanks and damaged rollers.

When considering the actual diameters of the blanks, care should also be given to the control of such undesirable features as out-of-roundness and lobing, because those will not be eliminated during the rolling process.

An example requiring particular care is that where the thread is to be continued near to a shoulder. The rolled thread will inevitably finish very slightly before the shoulder is reached, with the result that the unrolled portion of the blank will remain at its original diameter. It will, in effect, be an undercut of half thread depth for which allowance shall be made if, for instance, the component is required to screw into a threaded hold up to the shoulder. Such a condition is often met by producing a counter bore in the hole.

During the thread rolling operation there is sometimes a tendency for the material to flow over the end of the blank. This tendency may be obviated by the operation known as 'pointing' which consists chamfering the end of the blank, before rolling, to and included angle of 90° or, preferably, 60°. While not absolutely essential the use of pointing will assist in reducing the wear on rollers. In cases where an undercut has to be produced on a blank before rolling, it will help if the undercut is chamfered towards the rolling diameter, as this will obviate any undesirable flow of material into the undercut. A danger not readily apparent lies in the work rest situated between the rollers. A work rest set too low will tend to cause jamming between the blank and the rollers, while too high a setting may cause the component to be moved out radially as the rollers complete the thread. The setting should be very carefully and accurately controlled but the actual position for the best results in any specific plant can only be ascertained by trial and error. Allowance should be made for consequent enlarging of the diameter of the component during rolling. For general guidance it should be noted that with the blank component lying on the rest before the operation, its centre should be below the centres of the thread rollers by an amount slightly greater than half the depth of thread to be rolled. Upon completion of the operation the centre of the component should be approximately 0.012 mm below the roller centers. A variation of even 0.025 mm in this figure will have a very important bearing on the results and will be reflected in the running of the machines.

If a work-holder is employed, care should be taken that the blanks are not held too rigidly. The actual operation of the rollers, in conjunction with the height of the work rest, is the real factor in holding the components. A work-holder which is allowed to grip the component can not only ruin the work but cause serious damage to the rollers.

Extreme care is necessary when setting a machine for thread rolling operations. One of the most important factors is the relationship of the thread rollers. It is vital that the thread rollers are matched in the machine, that is, the axial position of each should be set to ensure that the threads are identical in the 'pitch' position. While it is easy to realize that the setting could be so badly out that the threads on the component could actually be split, it may not be so easy to visualize that the rollers could be set in such a position that the resultant thread would pass ordinary gauges but the life of the rollers would be considerably shortened by wear or actual breakage.

With careful and accurate setting of the rollers and the work rest with careful selection of the right material for the component and with accurate control of the diameter of the component to be rolled very long life can be expected from the rollers before wear makes regrinding necessary. Under normally good conditions the first evidence of wear may be expected to show on the crests of the threads, and, providing this is not excessive, it is possible to regrind successfully on several occasions before the unsatisfactory products make replacement necessary.

For the production of right-hand threads, a left-hand helix is necessary for the thread on the roll while for left-hand threads the converse is required.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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